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Duquesne University's Journalism and Multimedia Arts (JMA) department provides educational programming aimed at developing professionals in the digital media field. A core tenet of the program is cultivating student proficiency in the design and development of digital media programs and systems. The department prepares its graduates for roles as multimedia and e-learning developers in academic, healthcare, and corporate settings. Preparing students for work in these fields requires that the department and its faculty keep up with current technology and seek new approaches to support student learning. One innovation JMA recently implemented features Sonic Foundry's Mediasite video conferencing system, which can record, archive, and distribute class lectures online. The system makes recorded lectures available to students for review on an as-needed basis and enables geographically distant students to participate in on-campus classes.

In this article, we introduce Mediasite and document how two graduate courses enhanced the delivery of course content using the system. More specifically, we provide an overview of the system, describe how JMA faculty implemented it, note the ways students responded to it, and discuss its capability to support teaching and learning.

The Mediasite System

In the fall of 2003, Duquesne University's interactive media program (renamed the Department of Journalism and Multimedia Arts in 2005) began using Mediasite to broadcast class lectures over the Internet. Mediasite is a client-server application that requires a capture/encoding workstation, a server to broadcast recordings, and a Web browser to view presentations. The capture station records slides of the information displayed on the instructor's monitor (e.g., PowerPoint slides, applications, etc.) when it detects screen changes. A ceiling-mounted video camera can be positioned at several preset recording angles; the default position is on the instructor. The captured slides are synchronized with the video. The server distributes video using Microsoft's Streaming Media Server. The browser displays the Mediasite window, which contains two frames, one playing video and the other serving as a content area for the captured slides or graphics from the presenter's computer screen (Figure 1). Students watch the instructor lecturing with all accompanying visual support material at a resolution scaled to their Internet connection. In Figure 1, for example, one frame contains video of the instructor and the other displays the output of his computer. While the content frame in Figure 1 presents a PowerPoint slide, Mediasite is capable of displaying any application the instructor demonstrates (Figure 2).

Mediasite enables live broadcasts as well as archived recordings of entire classes that students can review independently based on their needs and preferences. This is particularly useful in computing-intensive courses, as students can review operations the instructor performs in a software application. Students can control the sequence of their review of archived material by accessing a list of all slides; by clicking a captured graphic, users can immediately see the video linked to that graphic. Various standard controls (i.e., Pause, Play, Slider, etc.) allow students to regulate playback. Another useful feature allows instructors to make compact discs (CD) or digital videodiscs (DVD) of recordings for distribution.

The system affords off-campus or distant students the opportunity to participate synchronously and asynchronously in on-campus classes. Students can access and search class content from any location. Those who miss class due to illness or travel requirements can review the lecture on their own. Each semester at Duquesne University, an average of 14 courses (6%) taught by full-time faculty and adjunct professors use Mediasite.

The system requires minimal technical expertise from instructors. Using the Mediasite software, instructors can simply select their class from a list of scheduled classes and then begin or stop recording with a simple click of a button. The system described here cost JMA approximately $29,000, which included the capture station and software and server software. The department also purchased a $4,000 maintenance agreement that includes on- and off-site support.

Mediasite in the Classroom

Mediasite enriched teaching and learning in two courses, Multimedia and Instructional Design (MMID) and An Introduction to Human Computer Interaction (HCI). MMID and HCI are graduate courses that use lecture, discussion, demonstration, and guided practice to teach students to develop and evaluate software applications. Both courses use software extensively. They are usually taught face-to-face in a laboratory, but because of inadequate lab space, JMA offered MMID online in fall 2004 and spring 2005.

MMID provides students with an overview of instructional design, instructional theory, and learning theory, leading them to author e-learning courseware using Adobe Authorware. This program is an icon-based "visual authoring tool for creating rich-media e-learning applications for delivery on corporate networks, CD/DVD, and the Web" (Adobe 2007, ¶ 1). Throughout the class, students complete short application exercises that prepare them to develop a capstone e-learning project using this technology.

HCI introduces students to the underlying theories that influence the design of user interfaces. By creating software prototypes, students learn about graphical interfaces, interactivity, and how to evaluate and refine computer-based applications.

Connecting Students and Teachers through Mediasite

Mediasite enhances these courses in several ways. Each class session is broadcast on the Internet and then archived, allowing students who are unable to attend classes due to illness or professional travel responsibilities to keep up with the class. Some instructors initially expressed concern that making lecture materials available to students online would result in lower class attendance. However, since implementing Mediasite in 2003, attendance in both MMID and HCI (which was first offered in fall 2005) has been consistently high. Mediasite's remote-access capability enriches classes further by enabling off-campus students to participate alongside on-campus classmates, which adds greater professional diversity to classes.

Mediasite allows students to reflect on the ideas presented in class in a way that suits their particular needs. Students can access lecture materials any time and organize the information presented in class in various ways. Students control the pace of instruction by accessing only the content they need to review and skipping unneeded information. This degree of access is a critical value that the system adds to these courses, allowing students and teachers to move beyond the limits inherent in traditional classroom communicating, recording, and reflecting.

Traditional class periods offer students insufficient time for reflection, particularly in classes that study software and computer applications. In the traditional versions of MMID and HCI students would usually take notes, which certainly can enhance their learning. However, excessive note-taking or trying to represent complex computing operations in written notes may interfere with knowledge acquisition. While an instructor demonstrates a software application, the flow of communication is, for the most part, continuous. In addition, much of the information is sequential, with later operations being contingent on those performed earlier. The instructor may stop to answer questions but generally the presentation proceeds based on the expectation that a majority of students are able to keep pace. During demonstrations in a laboratory, students frequently follow along at their computer terminals and replicate the operations the instructor performs. As students write notes, they shift focus between the instructor, typing on the computer, and note-taking, which invariably causes them to miss important steps. Many students fall behind because they are unable to take meaningful

notes or follow a demonstration. Mediasite allows students to focus on class activities without trying to write everything down. Those who benefit from written notes can write observations as they study the materials outside of class, at which time they can pause the presentation. Moreover, video can capture complex, intangible concepts and minute intricacies that can be replayed (Mu, Marchionini, and Pattee 2003; Heinich, Molenda, and Russell 1989; Brown and Fortosky 1986), which may alleviate the cognitive load on students as they try to record details of complex operations.

Mediasite also helps students perform classroom assignments. In MMID and HCI, the instructor assigns students multiple developmental projects throughout the semester that require the use of various computing and software tools. During classes, the verbal and non-verbal communications that occur are essentially lost unless students record them in some way. Likewise, in computing intensive courses, the operations modeled or demonstrated by the instructor on the computer are gone. MMID and HCI require extensive use of sophisticated software and repeated demonstrations of how to build applications with it. Because Mediasite archives the lectures, students can use it while working on class projects to study how the instructor accomplished specific tasks. In fact, students can reconstruct the steps performed by the instructor to learn precise software functions, which improves their efficiency and accuracy when troubleshooting. For example, a student may have fallen behind in class midway through a guided practice activity on programming interactive structures. After class, the student locates the section of the activity in the archived class presentation, clicks on the corresponding slide, and then watches and listens to the demonstration. He or she can observe where the instructor places the computer mouse, selects functions, and writes programming code. In this way, students complete the activity at their own pace and review the materials as needed to reconstruct the tasks performed by the instructor.

Allowing students to control the sequence of the instruction, decide the content to be studied, and review content when needed are essential to mastering the techniques taught in these two classes. It also encourages students to own their learning. Driscoll (2002) points out that the student who is active is likely to be more responsible for his or her learning than one who sits passively while the teacher lectures. Mediasite facilitates an active engagement with the lecture and with the material being taught.

Implementation

MMID

In the fall 2004 and spring 2005 semesters, laboratory space restrictions prevented MMID from being offered in a face-to-face environment. To meet student demand, the department created an online section of the class, which required the development of online materials. In the summer of 2004, the instructor used Mediasite to record an introduction to the class, weekly lectures, software demonstrations, and frequently asked questions (FAQs) (Exhibit 1). He also created a Web site that provided links to the recordings. Each week, the instructor assembled readings for students, which were reinforced or supported by a Mediasite lecture. In most cases, he supplemented lectures with software demonstrations (also recorded in Mediasite) that illustrated how to build an application or segments of one. Students downloaded assets from the class Web site and, following the demonstration, created the application. Each lecture/demonstration lasted for approximately two hours and forty minutes. In addition to the aforementioned materials, students discussed relevant topics and interacted with several e-learning experts via an online discussion forum. As the semester progressed, common questions arose about the software. For example, students often e-mailed the instructor with questions about creating interactions and collecting user input with Authorware. In such cases, the instructor used Mediasite to create video FAQs in which he discussed the question and illustrated solutions.

Online classes are often considered low in social presence compared to face-to-face interaction because of the absence of many social and visual cues (Walther 1992). Since MMID was online with no face-to-face class meetings, the instructor strove to personalize the class as much as possible, but logistical difficulties made this complicated. Because the department did not own a portable Mediasite system, the instructor had to record the sessions in a laboratory that was frequently occupied by other classes. Due to the difficulty of

accessing the laboratory, he periodically resorted to using Camtasia Studio to record a sequence of computer screen shots with narration that illustrated specific solutions (Exhibit 2). Even without the video of the instructor, the approach worked well, primarily because it gave the instructor flexibility. As questions arose, he produced a recording with Camtasia and then streamed it on the Web.

Lessons Learned

As the online version of MMID progressed, instructors observed how students adapted to Mediasite's strengths and weaknesses. Many students preferred to expand the graphic image of the computer screen and listen to the audio, rather than watch the instructor. For example, during software demonstrations of Authorware, students could open the slide frame full-screen and watch and listen as the instructor performed specific operations. In this case, whatever visual cues the instructor might have given during the lecture were, for many students, excess information.

Students discovered another use for the live camera link—as a compensation for one of Mediasite's weaknesses. In some cases, demonstrated operations moved too quickly for Mediasite to capture, and as a result students using the recorded class missed critical steps. For instance, as an instructor performs an Authorware operation, numerous steps may occur in rapid succession. Mediasite's screen-capture rate did not keep perfect pace with the demonstration and failed to record several steps (Exhibit 3). Obviously, this kind of error can confuse students who might rely solely on the Mediasite slide-capture capability. However, one aspect of the recording sessions allowed for a workaround. As the instructor recorded lectures, his computer display was not only reproduced within the Mediasite screen capture, but also projected behind him onto a screen in the laboratory; the projected image illustrated in real time the operations he performed on his computer. Some students therefore requested that the video camera that recorded the instructor be repositioned to show the laboratory projection screen, thereby allowing them to capture those lost steps (Exhibit 4).

The classes observed technical problems as well. Some students reported that video played intermittently and that they experienced excessive delays when trying to access some content, despite Mediasite's claims that the system scales its presentation to the user's Internet connection. Brief delays are tolerable when accessing one or two segments, but as the degree to which one interacts (e.g., play, stop, rewind, fast-forward) with the video increases, they add up to a significant problem. To alleviate this issue, the instructor copied the recordings to CD-ROM and DVD. Most of the lectures lasted two hours and forty minutes, but none occupied more than 645 megabytes of disk space.

Instructors at JMA also discovered that the recorded materials became useful in subsequent semesters, even when MMID was offered face-to-face. Students who wanted additional materials for review had access to an archive of lectures, slides, and video.

HCI

In the fall of 2005, students in the HCI course performed usability tests on several prototypes they developed. A usability study involves "any technique a developer might use to create a design from a user-centered perspective" (Brinck, Gergle, and Wood 2002, 14). Students tested each application based on criteria that assessed the interface and programming for visual, informational, and navigational adequacy.

Students recorded the test sessions with Mediasite. During testing, a moderator read a script that informed an evaluator about the test and instructed him or her to perform several tasks using the prototype while thinking aloud. As the evaluator performed each task, Mediasite recorded verbal and nonverbal expressions as well as the computer operations. After the sessions, a link was placed on the class Web site for students to access their video, which they reviewed as they improved the prototype.

Lessons Learned

The instructor and students noted several advantages in using Mediasite for user testing. First, the recorded sessions allowed them to observe and study how users interacted with the prototypes. The integration of media elements (i.e., computer screen, audio, video) enabled users to see and hear people as they experienced difficulties and to detect the exact location of those problems. A second notable asset is that Mediasite seemed invisible during such testing. Evaluators are often uncomfortable in a testing environment, especially when sophisticated equipment is being used. In the HCI course, once the testing sessions began, evaluators proceeded as if they were unaware of Mediasite.

However, the erratic screen-capture rate and sluggish video load-time, described as problems in earlier courses, hindered student use of Mediasite in the HCI course as well. When reviewing the recordings, students noticed that specific operations referred to by evaluators often did not appear in the slides. This frustrated students since, in some cases, evaluators talked about problems in the prototype and reviewers were unable to see the exact sequence of actions that provoked those problems. In addition, to make observations from the recordings, a relatively high degree of interaction with the video was necessary. For each interaction (e.g., fast-forward, play, rewind) students had to wait several seconds for the video to load. Some became discouraged from making adequate observations because of these delays.

Observations and Recommendations

Some of the observations noted above were provided by students who sent e-mail messages to their instructors during the semester. In our final review of these messages, we grouped student commentary into three main categories: a) e-mail complimenting Mediasite, b) e-mail communicating questions about or problems with Mediasite, and c) e-mail referring to class attendance. We included a fourth group, labeled *Other*, for e-mail that did not fit the other categories. Of the 24 e-mail messages reviewed, most related to questions about or problems with Mediasite and how students intended to use it because they were unable to attend in-class lectures. E-mails referring to problems are mainly comprised of complaints about download time and access (Table 1).

Overall, the student feedback received by instructors varied depending on the format of the course in question. On the one hand, the in-class comments and observations from students taking the course on campus indicated that they recognized the value of Mediasite and used it regularly to supplement the face-to-face class sessions. Significantly, instructors in these sections received relatively few complaints about the system or questions about how to use it. On the other hand, many e-mails expressing inquiries or problems were received by instructors using Mediasite for completely online courses. In these classes, students' primary means of acquiring content was through the system. This suggests that as student dependency on the system increases, students become more discerning and are more likely to offer unsolicited critiques. Conversely, students in face-to-face classes that use Mediasite have access to both in-class lectures and archived recordings. Therefore, when they encounter difficulties with a recording, they may be less inclined to mention it to the instructor because the information is accessible in or after class.

While we did not perform a systematic evaluation of Mediasite's impact on student learning or of student responsiveness to the system, our experience with the system has led us to formulate a number of observations and recommendations about its use (Exhibit 5). These points arise from our own experience with a particular system, but most of them have broader applicability to instructors who may be considering similar videoconferencing tools in their work. In particular, instructors not only should ensure consistent levels of technical support; they also should integrate such technology into course activities to keep students sufficiently accustomed to it, rely on shorter video segments to suit student preferences, provide alternative means of distribution (i.e., DVD or CD-ROM) to bypass any access problems, and use the technology creatively to promote the sustained engagement of off-campus students.

Conclusion

As academic programs strive to prepare graduates as professionals in the digital multimedia and e-learning

fields, they face a number of challenges including maintaining technological currency and offering innovative approaches to support learning. Videoconferencing systems offer much potential as a means of meeting such challenges, and in our experience at the JMA department at Duquesne University, we found Mediasite to be a valuable asset to support teaching and learning. Specifically for the MMID and HCI courses, the system provides students a resource that they can use independently and according to their learning needs. However, while the system offers many advantages to support learning, it has limitations. For activities that required highly detailed real-time observations, screen capture rates limit the extent to which viewers can follow a presenter. Moreover, as the degree to which students need to interact or control the recording increases, video access time will likely become more problematic. Instructors who wish to employ this technology therefore will need to adopt flexible strategies to minimize such potential problems; in turn, similar measures will no doubt be necessary for the use of any current videoconferencing technology regardless of how advanced it may be in its features. Nevertheless, in light of the genuine benefits afforded by such systems, extra diligence on behalf of their users remains a worthwhile investment to ensure their effective use as online learning tools.

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